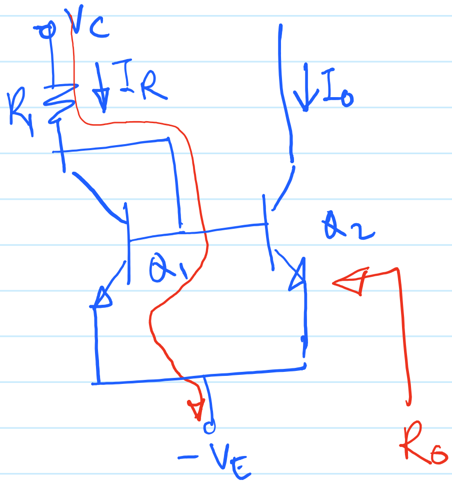
IC Biasing-2

Wednesday, November 2, 2016 8:31 AM

Two transistor Biasing Circuit



$$I_o = \frac{I_R}{1 + \frac{2}{\beta}}$$

$V_A = \infty$

$r_o = \infty$

$$R_1 = \frac{V_C + V_E - V_{BE}}{I_R}$$

$V_A \neq \infty$

$$I_C = I_S \left(e^{V_{BE}/V_T} - 1\right)\left(1 + \frac{V_{CE}}{V_A}\right)$$

$V_{BE_1} = V_{CE_1}$

connected together

$$\frac{I_{C_2}}{I_{C_1}} = \frac{1 + V_{CE_2}/V_A}{1 + \frac{V_{BE_1}}{V_A}}$$

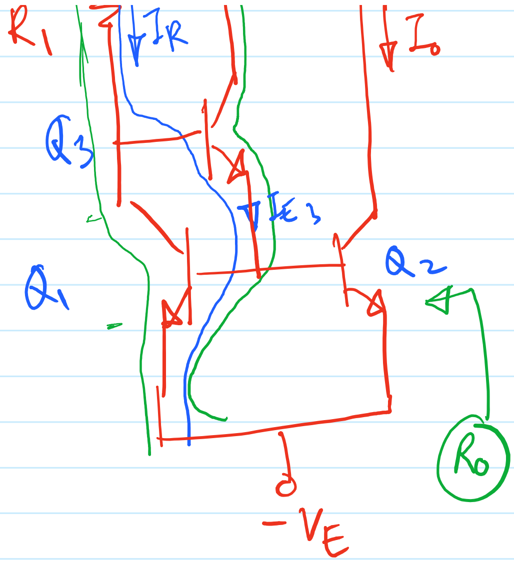
$$R_o = r_{o_2} = \frac{V_A}{I_{C_2}}$$

$I_o = 5\mu A$ $I_R = 5.1\mu A$

Modified Circuit : 3-transistor Biasing Circuit

Identical β

identical β



Formulate the relationship between I_R and I_o and design the circuit

$V_C = I_R R + V_{BE} + V_{BE} - V_E$

$$\therefore R = \frac{V_C + V_E - 2V_{BE}}{I_R}$$

$I_{C_1} = I_{C_2} = I_o$ $\quad [V_{BE_1} = V_{BE_2}, \; I_{B_1} = I_{B_2}, \; I_{C_1} = I_{C_2}]$

$I_R = I_{C_1} + I_{B_3}$ $\quad I_{E_3} = (1+\beta) I_{B_3}$

$I_{E_3} = I_{B_1} + I_{B_2} = 2 I_{B_1}$

$= (1+\beta) I_{B_3}$

$$I_{B_3} = \frac{2 I_{B_1}}{(1+\beta)}$$

$$I_R = I_{C_1} + \frac{2 I_{B_1}}{(1+\beta)}$$

$$= I_{C_1} + \frac{2 I_{C_1}}{\beta(1+\beta)} = I_{C_1}\left[1 + \frac{2}{\beta(1+\beta)}\right]$$

$$= I_o \left[1 + \frac{2}{\beta(1+\beta)}\right]$$

$$= 5\mu \left[1 + \frac{2}{100(1+100)}\right] \doteq 5.0\,\mu A$$

I

$$[\;\ldots\; 100(1+100)]$$

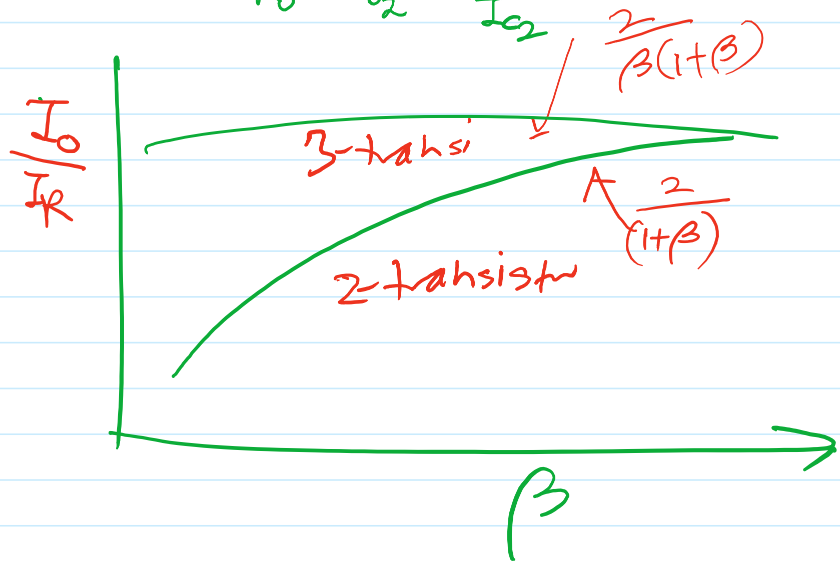
$$\therefore\; I_o = \frac{I_R}{1 + \frac{2}{\beta(1+\beta)}}$$

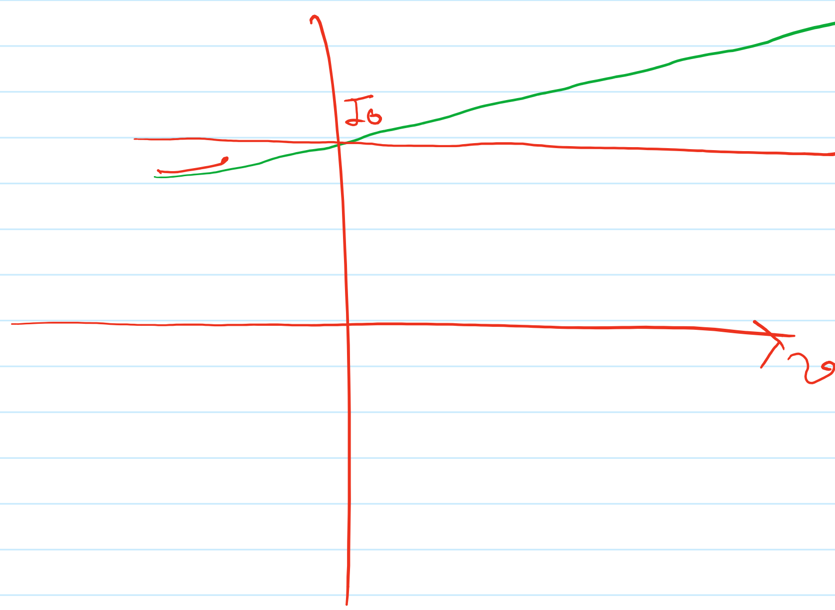
$$R = \frac{30 - 0.7\times 2}{5\mu}$$

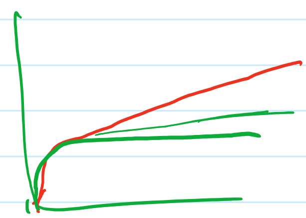
(*) $V_{CC} = 30\,V$, $V_{BE} = 0.7$, $\beta = 100$

$I_o = 5\,\mu A$

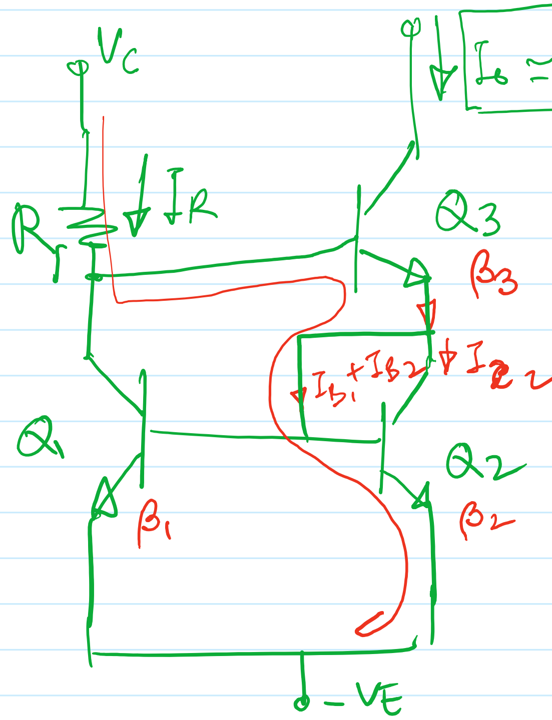
$$R_o = r_{o_2} = \frac{V_A}{I_{C_2}}$$







WILSON CURRENT SOURCE



$I_o \simeq I_R$

$$R_1 = \frac{V_C + V_E - 2V_{BE}}{I_R}$$

$$\beta_1 = \beta_2 = \beta_3 = \beta$$

$$I_R = I_{C_1} + I_{B_3} \quad (1)$$

$$I_{B_1} = I_{B_2} \quad [V_{BE_1} = V_{BE_2}]$$

$$I_{C_1} = I_{C_2}$$

$$I_{C_3} = I_o = \beta I_{B_3}$$

KCL

$$I_{E_3} = (1+\beta) I_{B_3} = I_{C_2} + I_{B_1} + I_{B_2}$$

$$= I_{C_1} + 2I_{B_1} = I_{C_1} + \frac{2I_{C_1}}{\beta}$$

$$= I_{C_1}\left[1 + \frac{2}{\beta}\right]$$

$$\therefore I_{C_1} = \frac{(1+\beta) I_{B_3}}{\left[1 + \frac{2}{\beta}\right]}$$

$$I_R = I_{C_1} + I_{B_3}$$

$$= \frac{(1+\beta) I_{B_3}}{1 + \frac{2}{\beta}} + I_{B_3} = I_{B_3}\left[\frac{(1+\beta)}{1 + \frac{2}{\beta}} + 1\right]$$

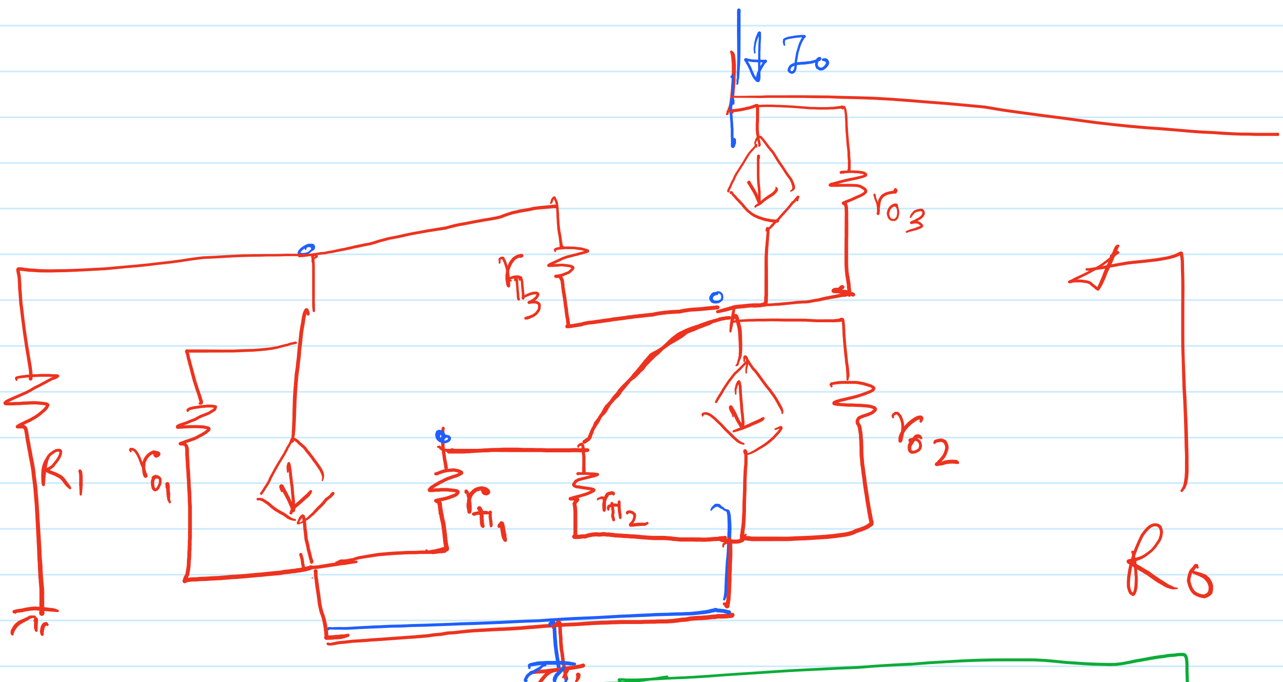
$$= \frac{I_o}{\ } \left[\frac{(1+\beta)}{\ } + 1\right.$$

$1+\frac{\ }{\beta}$

$$= \frac{I_o}{\beta}\left[\frac{(1+\beta)}{1+\frac{2}{\beta}} + 1\right]$$

$I_o = 5\mu A$, $V_C = 30V$ $V_{BE} = 0.7$ $\beta = 100$

$$I_R = \frac{5\mu}{100}\left[\frac{101}{1+\frac{2}{100}} + 1\right] \simeq 5\mu A$$



$$R_o = r_{o2}\left(1+\frac{\beta}{2}\right)$$